

Divisional Inquiry Report
815-11-01
iSail #20144



INCIDENT INFORMATION

Vessel/Terminal Name: Nanaimo Harbour Terminal
Incident Type: Portion of trestle collapsed/Vehicle in water
Incident Date: 0315 hours August 12, 2011

INVESTIGATION INFORMATION

Chair:

Original Signed By

(Chair's Signature)

January 4, 2012

(Date)

Panel Members: Director, Terminal Construction
Trades Supervisor/Dock Repair/Welding

Interviews: Trades Supervisor, Nanaimo Terminal Maintenance
Dock Repairman, Nanaimo Terminal Maintenance
Regional Manager, Nanaimo
Nanaimo Port Authority
Regional Manager, Nanaimo Terminal Maintenance

APPROVAL

❖ Convening Authority

Original Signed By

(Convening Authority's Signature)

January 4, 2012

(Date)

Date of Incident: August 12, 0315 hours

Location of Incident: Nanaimo Harbour (trestle)

Type of Incident: Portion of Trestle collapsed/Vehicle in water

Section 1 – Summary of Events

1.1 A Nanaimo based paving contractor, was completing scheduled night time paving of the Nanaimo Harbour timber trestle following last sailing on August 11th, 2011 and prior to first sailing on August 12th, 2011. At approximately 0315 hours August 12th, a tandem axle dump truck backing down the trestle to deliver asphalt to a paving machine, travelled onto a restricted section of the trestle designed only for passenger walkway loading. The rear axle driver's side wheel group overloaded this cantilevered walkway section of the trestle, causing structural failure collapse of two spans of the walkway and the vehicle to overturn and fall into the water, then at high tide. The driver escaped from the truck with a minor hand injury and swam to shore. The paving company asphalt machine operator just beyond the collapsed walkway spans and a BCF Terminal Maintenance bridgeman in a punt just under the trestle below where the truck fell through, both also narrowly escaped injury. Damage to the trestle was extensive and required closure of the terminal and re-routing foot passengers and vehicles until recovery and repairs could be completed.

Section 2 – Trestle Structure

2.1 The Approach Trestle is constructed of creosote-treated timber piles (40) arranged into bents (rows of piles) numbered from 1 (the trestle abutment at shore) through to 9 (forming part of the ramp abutment). The trestle extends eastward and seaward and curves into a northerly direction. The trestle consists of a single vehicle lane (14 feet or 4.3 m wide) on the inside curve and a walkway (4 feet or 1.2 m wide) on the outside (or east side) of the curve. The trestle is 137 feet (or 41.7 m) long and has a posted load limit of 39,500 Kg GVW (maximum 5 axles).

The trestle was originally constructed in 1965. The trestle typically contains three pile bents which support the timber roadway superstructure above. Cantilevered pile caps, which extend beyond the outer piles of each bent, support the walkway section. The superstructure includes: timber caps (12" x 12" creosote treated), longitudinal stringers (6" x 14" creosote treated), transverse plank decking (4" x 12"), a chip-seal wear surface, timber bull rails (8" x 8" continuous curbs, three runs), posts (4" x 4" @ 10') and handrails (2" x 6" top rail, 2" x 4" u/s and mid-rails). The bullrail/handrail connection has been retro-fitted and reinforced with fabricated steel bracket supports along the entire west side (i.e. the inside of the curve). The transverse plank decking forming the walkway, only spans two stringers and was not continuous across the structure. In 1973, the trestle was flared at the shoreward end, on the outer curve, to improve the wide turn of trucks entering and leaving the holding compound. This work included adding piles to support the ends of the cantilevered caps in Bents 2 and 3.

From trestle construction and until 2006, an 8" x 8" timber bull rail separated the vehicle deck from the passenger walkway. This marked the roadway surface, to prevent vehicles from travelling on the walkway. However, long trucks have experienced difficulty in negotiating the curve and were frequently rubbing or riding up the curb, causing the need for maintenance repairs. In 2006, the curb was removed and replaced with delineators, plastic tubing spaced and affixed along the curb track, to gain some additional inches of roadway and to provide a visible means for truckers to observe the boundary.

In 2010, Terminal Maintenance, looking to reapply chip seal, determined that paving the trestle deck instead, would provide a more durable and smoother surface to improve on safety and performance. Terminal Maintenance contracted an engineering company to investigate the trestle to determine whether or not the structure could take the additional dead load of the asphalt, without compromising the load limit. The engineering company confirmed that “the decking, pile caps, piles and cross braces appeared to be configured as per the original design and expansion modifications. It was determined that the current decking size had adequate capacity to support the proposed asphalt surface.” The engineering company further concluded “that the trestle would be capable of the additional 3” layer of asphalt if certain structural criteria and conditions were met.”

The structural criteria and conditions were completed and the trestle paving scheduled for August 11/12, 2011.

Section 3 - Sequence of Events

3.1 Environmental Conditions

Weather

August 11th

2200 hours Temp. 15.3C wind speed 9km
 2300 hours Temp. 17.0C, wind speed 6km

August 12th

0200 hours Temp 14.5 wind speed 7km
 0300 hours Temp 14.5 wind speed 9km

Tides

Nanaimo, British Columbia – August 11, 2011/August 12, 2011

August 11th

1827 PDT	4.38 meters High Tide
2346 PDT	3.18 meters Low tide

August 12th

0417 PDT	3.87 meters High tide
1127 PDT	0.82 meters Low tide

3.2 Project Planning

- The trestle was built in 1965, with Bents 1 through 3 having had additional piles, stringers and planks modified in 1973. As a result, the entire width of the trestle could support vehicle loading out to Bent 3, while between Bents 3 and 9, the cantilevered walkway was not capable of supporting vehicle loading. A bull rail separated the vehicle capable superstructure from the walkway area the entire length of the trestle.

- Due to damage caused from vehicles driving against the traffic separating bull rail, they were removed sometime in 2006. Delineators were installed to identify and separate vehicle and foot passenger traffic areas.
- Alert SI-0030 completed in May 2009 identified a tripping hazard in the chip seal which covered the trestle. In 2010 Terminal Maintenance determined that paving the trestle would prevent injuries and reduce maintenance costs.
- Two site visits were completed with co-owner 1 of the paving company. In December 2010 the paving company submitted a quote with two options for repair. A 3rd site visit was completed with co-owner 1. Type of equipment used, paving area, construction methodology, materials and time frame were considered. All discussions were verbal and a written work plan was not completed. With two passes of paving required to cover the width of the trestle, BCF advised the paving company that the asphalt truck could deliver asphalt to the spreader only on the vehicle portion of the trestle (first pass) and that for the second pass, which included the walkway area, the asphalt truck could not advance past Bent 3 and that the spreader would need to move up to Bent 3 for filling as required.
- In May 2011 the engineering company completed the Structural Review to determine if the existing trestle had the capacity to withstand an increased asphalt dead load. The engineering company concluded the trestle would support the addition 3" layer of asphalt if certain conditions were addressed.
- May 26, 2011 a PO was opened for the paving company. Discussions were held with terminal operations regarding the time line of paving and the noise bylaw application/exemption. An agreement was made to begin paving on August 11th at 2230 hours and end at 0500 hours August 12th.
- BCF employees worked their regular shift 0600-1700 hours on August 11th, and rested for approximately two hours in the evening prior to returning for work at 2230 hours.
- To complete renovations on the foot passenger waiting room the CCTV had been disabled and footage of the incident was not available.

3.3 Site orientation/safety discussions

- At approximately 2230 hours a site safety orientation with six contractor employees was held at the job site. The safety orientation consisted of the completion of acknowledgement forms (dated August 11th), discussions regarding the noise bylaw and PPE requirements. In addition copies of the Contractor Safety Guidelines booklet were issued to everyone.
- At approximately midnight a brief site safety orientation was completed with co-owner 2 and a passenger in the truck. Co-owner 2 had not attended any of the site visits in the pre-planning stages of the project. The acknowledgement forms were signed (dated August 12th) and PPE requirements outlined. Due to time constraints, walking the trestle was not part of the site orientation.
- Co-owner 2 advised BCF that he had been fully updated on the job requirements including safety concerns. Co-owner 2 having arrived late was anxious to leave the site to pick up a load of asphalt.
- BCF did not discuss any specific areas of concern that involved restricted use of the asphalt truck with co-owner 2 and passenger. The initial discussions and decisions were agreed to by co-owner 1. BCF was under the assumption that co-owner 1 had relayed all of the job requirements and safety concerns discussed in the planning stages to the paving employees.

3.4 Activities Surrounding Incident

- On August 10th Terminal Maintenance removed delineators, swept the trestle and installed temporary cones. On the 10th or 11th of August 2011 co-owner 1 advised that he was unable to attend the work site when the paving was scheduled to be completed. Co-owner 1 advised that co-owner 2 had been updated on the paving job requirements and would be on site with the crew
- At 2230 hours on August 11, 2011 two BCF employees and six paving employees were on site. BCF provided the site orientation. Co-owner 2 and the passenger would later arrive at the site over an hour late (no reason was given).
- After the last sailing BCF and six employees from the paving crew walked down the trestle removing the temporary cones dividing the vehicle portion of the trestle from the pedestrian portion. BCF explained that the asphalt truck could only drive on the vehicle portion of the trestle.
- The paving crew prepared the trestle, brushing and spraying colas, walking the asphalt spreader back to the berth area and rolling out fabric cloth. A BCF employee was positioned in the workboat underneath the trestle to ensure all environmental concerns were met.
- At approximately 2345 hours Co-owner 2 and the passenger arrived in an empty gravel truck towing an asphalt spreader. The asphalt spreader was unloaded and walked down the trestle. Although the paving site had been prepped and was ready for paving, there was a further delay of waiting for the delivery of asphalt.
- The asphalt yard is south of Duke Point. It was estimated that the project would be approximately 1 ½ hours off schedule. The asphalt truck arrived back at the site at approximately 0015 hours with the first load of asphalt. Co-owner 2 and the passenger backed down the trestle in the designated vehicle roadway area. The paving truck used was 29 feet long, 8 feet wide with a GVW of 34,000 kg.
- Eight paving company employees were on site working on the trestle. One BCF employee was in a workboat under the trestle, one BCF employee was monitoring the work progress on the trestle and taking photographs throughout the paving process. The asphalt truck backed down the vehicle side of the trestle and filled the asphalt spreader hopper. Employees with wheelbarrows would spread the asphalt in areas that the asphalt spreader could not reach.

3.5 Near Miss

- The first portion of the trestle to be paved was the designated vehicle lane. When the vehicle lane was completed the asphalt spreader moved to the pedestrian lane at the ramp abutment and distributed the remaining asphalt. The asphalt truck (near empty) had backed up and was stopped in front of the asphalt spreader. Approximately half of the truck was on the vehicle lane and half on the designated foot passenger walking lane.
- The asphalt truck left the trestle to pick up a second load of asphalt. BCF employees noticed that the asphalt truck had been on the restricted area of the trestle and upon leaving had cracked a plank on the deck. BCF replaced the plank.
- BCF employees met with the on site paving company employees. BCF reviewed the safety requirement and restrictions concerning where the asphalt truck was required to stop. The asphalt truck was not to proceed past Bent 3 and the asphalt spreader was to walk up to the asphalt truck. Co-owner 2 and the passenger were not part of this discussion as they had left to obtain the second load of asphalt. The time frame to complete the work remained off schedule. BCF had concerns that the paving of the trestle would not be completed prior to the vessel arriving for the first sailing.

3.6 Incident

- BCF employees returned to the terminal maintenance yard and retrieved materials to repair the damaged plank. BCF returned to the trestle, removed the damaged plank and installed the new plank. The asphalt truck had not yet returned with a second load.
- At approximately 0305 hours the asphalt truck returned with the 2nd load and BCF moved the service truck from the entrance of the trestle. Prior to the asphalt truck backing down the trestle a paving company employee stopped the truck and spoke with co-owner 2. BCF assumed that co-owner 2 had been advised that he was required to stop at bent 3 and allow the asphalt spreader to walk up to the truck for the asphalt.
- The asphalt spreader began walking up from the bent 5 area to meet the asphalt truck as it backed down the trestle towards bent 3. A BCF employee was standing on the vehicle portion of the trestle near bent 1. A second BCF employee was under the trestle in the workboat picking up debris that fell into the water. The remaining paving company employees were standing in various areas of the trestle waiting for the asphalt spreader to meet the asphalt truck. The passenger of the truck was standing on the trestle motioning and directing co-owner 2 in the asphalt truck as it was backing up.

Note: Co-owner 2 advised Director, Security Programs in a telephone conversation that the passenger in the asphalt truck had been directing him as he was backing unto the trestle.

- BCF employees heard the sound of wood breaking and observed the asphalt truck near the bent 3 area falling backwards. As the truck fell portions of the stringers and planks on the pedestrian side of the trestle broke away and fell into the water. The trestle sustained damage between bents 3 and 5. The asphalt spreader unit on the trestle remained near bent 5 and was partially hanging over the trestle. The asphalt truck landed on its roof in the water with the front of the truck facing towards shore.
- Several pieces of broken stringers, railings and planks fell into the water, hitting the front of the workboat and pinning it to the piles and braces between bent 2 and bent 3. The BCF employee in the workboat was not struck by any debris. He was unable to move the work boat and climbed the braces to the shore.
- Co-owner 2 in the asphalt truck exited by the open passenger window and was on the shore. Co-owner 2 advised he was not seriously injured and had a small cut on one hand. The tide was quite high at the time of the accident and it is believed that this prevented the driver from receiving serious injury.
- Several persons contacted 911 for assistance. A BCF employee directed the paving crew to open the terminal gates to allow emergency equipment access. The fire and ambulance services arrived and treated the driver of the asphalt truck. RCMP Nanaimo detachment attended the scene and completed an accident report. BCF on site contacted the Terminal Maintenance Manager.
- At approximately 0346 hours the Operations Security Centre received a report of the incident from a BCF employee. Emergency Operations Centre members were contacted and assembled in the OSC. Nanaimo Port Authority, Canada Coast Guard, MTCS, Burrard Clean were advised of the incident
- Nanaimo Port Authority managed the environmental response and clean up with BCF which included deploying booms, utilizing a patrol vessel on site, engaging a Vancouver Pile driving barge that had been working at the Nanaimo Port and the removal of asphalt from the seabed. Communication was maintained throughout the incident with all regulatory bodies including Transport Canada Safety and Security departments, MCTS, Burrard Clean, Canada Coast Guard and Environment Canada.

- The EOC & OSC teams managed the Service recovery plan establishing water taxi services for foot passengers, route 19 vessel movement to Duke Point, signage, telephone communication and re-routing and service notice updates for customers.
- Frequent conference calls between the site commander and EOC team ensured all aspects of the incident recovery operation were communicated to senior management and updated in isail # 20144.

When the accident occurred three persons at the work site narrowly missed serious injury or death.

- Co-owner 2 escaped from an open passenger window after the truck had overturned and landed in the water. The tide was high and cushioned the fall of the truck allowing the driver time to exit.
- The BCF employee in the workboat under the trestle escaped injury/death when the stringers and planks broke away from the trestle and fell into the water all around the workboat. Although the workboat was pinned to the pilings between bent 2 and 3 he was able to climb the braces on the pilings and reach the shore.
- The operator of the asphalt spreader was moving forward towards the asphalt truck when the trestle began to collapse. The asphalt spreader remained hanging over the trestle near bent 5 and the operator was able to dismount and move away from the equipment and damaged trestle.

The paving company declined to participate in the Divisional Inquiry therefore no interviews have been conducted with their employees.

Section 4 - Findings

#	Finding	Contributing causes	Root cause
4.1	In December 2010 Nanaimo Terminal Maintenance initiated a project to pave the Nanaimo Trestle. The paving company submitted quotes on 3 separate trestle projects and was selected to complete the paving job on the Nanaimo trestle.	A Purchase Order (PO) was completed. Service contract was not established.	Lack of understanding of Supply Chain Management.
4.2	<p>1. Three site visits were completed between BCF and co-owner 1 of the paving company. These site visits included discussions regarding the type of asphalt to be used, paving area and the vehicle and foot passenger designated portion of the trestle.</p> <p>2. Co-owner 1 that attended the site visits did not attend the work site on the night of paving.</p> <p>3. It is unknown if Co-owner 2 was aware that the asphalt truck could only be used on the vehicle only portion of the trestle.</p>	<p>All discussions with co-owner 1 were verbal.</p> <p>Co-owner 1 attended all three site visits and did not show up at the work site on night of paving.</p> <p>The safety concern related to the cantilever portion of trestle was not communicated directly to co owner 2 by any BCF employee.</p> <p>After the removal of the original safety markings the safe operating area was not defined with any temporary safety markers.</p>	<p>No written work plan completed for project.</p> <p>No current policy or procedure in place defining when a risk assessment is required.</p> <p>Lack of critical analysis of on-site risks.</p>
4.3	<p>Both BCF employees worked a regular shift on August 11th and rested for approximately two hours in before returning to work at 2230 hours.</p> <p>Lack of planner available to complete work plan and risk assessment of project.</p> <p>Accident occurred at approximately 0315 hours.</p>	WorkSafeBC Human Factors on work schedules and fatigue in 2009 indicated that sleep loss can produce a decline in performance such as slower reaction times, failure to respond to changes and the inability to concentrate and make reasonable judgments.	<p>Lack of resources (planner) in department to assist with on site project work.</p> <p>No current policy or procedure in place defining when a risk assessment is required.</p>

#	Finding	Contributing causes	Root cause
4.4	<p>Both parties were scheduled to meet at the work site at 2230 hours. Co-owner 2 arrived over an hour late.</p> <p>It is unknown if co-owner 1 and co-owner 2 had a discussion on the safety requirements when paving the trestle. There was a belief that the job had to be completed that night.</p>	<p>Communication breakdown between BCF and contractor completing the paving project.</p> <p>Lack of job understanding concerning safety issues with workers on site.</p> <p>Paving equipment not pre-staged.</p>	<p>Lack of clarity on site safety concerns.</p> <p>No written work plan to distribute or review.</p> <p>Lack of critical analysis of on-site risks.</p> <p>Lack of clear policy that supports on site supervisor authority to make change to project.</p>
4.5	<p>The asphalt truck arrived late at the work site and the site safety orientation to co-owner 2 and the passenger, both paving company employees was rushed.</p> <p>No safety site orientation including walking the job site was completed as the paving employees were anxious to leave so they could pick up asphalt.</p>	<p>Work project off schedule causing potential operational concerns and stress to finish paving job in allotted time schedule.</p>	<p>No current policy or procedure in place defining when a risk assessment is required.</p> <p>Lack of clarity on site safety concerns.</p> <p>Lack of critical analysis of on-site risks.</p>
4.6	<p>1. Asphalt truck noted on restricted area of trestle. This is considered a near miss.</p> <p>2. BCF reviewed and physically demonstrated the safety requirements and restrictions with the paving company foreman. BCF explained that the asphalt spreader was required to walk up the trestle and retrieve the asphalt from the asphalt truck at bent 3.</p> <p>3. The asphalt truck returned with the second load, the paving company foreman stopped the asphalt truck and spoke to co-owner 2.</p>	<p>Fatigue</p> <p>Assumption that the foreman passed on the safety information to the driver.</p> <p>No direct communication with driver.</p> <p>Safety concern not communicated to all persons at work site.</p>	<p>Lack of resources on site.</p> <p>Lack of work plan.</p> <p>Lack of critical analysis of on-site risks.</p> <p>Designated site specific supervisor from both BCF/ Paving Company did not remain on site.</p>
4.7	<p>Paving project focused on terminal and fleet operations, municipal noise bylaw and environmental concerns.</p> <p>Safety concerns and lack of specific safety work plans indicate the risk factor of weight restrictions on the foot passenger portion of the trestle may have been underestimated.</p>	<p>Paving projects routinely carried out by Terminal Maintenance are not considered high risk.</p>	<p>No written work plan to distribute or review.</p> <p>No current policy or procedure in place defining when a risk assessment is required.</p>

			<p>Lack of critical analysis of on-site risk.</p> <p>Lack of Training in completing Hazard and risk assessments.</p>
#	Finding	Contributing causes	Root cause
4.8	<p>Terminal Construction had a capital project underway at the Foot Passenger waiting room which is located at the entrance to the trestle. The cctv had been disconnected several months prior. No cctv coverage of incident available.</p> <p>Having the cctv connected would not have prevented the incident however it would have been most useful in reconstructing the events.</p> <p>The cctv was re-connected by request the same day.</p>	<p>A separate terminal construction project on the Nanaimo Harbour Terminal required cctv to be disconnected.</p> <p>There was no communication between the project team, terminal operations or terminal maintenance regarding timeframe that the cctv could be re-connected.</p>	<p>No current policy or procedure in place defining when a risk assessment is required.</p>
4.9	<p>As a result of this investigation it was determined that several other BCF trestles held a similar safety concern regarding restricted vehicle use.</p>	<p>Safety concern related to the paving of trestles had not been previously considered. This was the first trestle to be paved by BCF.</p>	<p>Unknown safety issue.</p> <p>No current policy or procedure in place defining when a risk assessment is required.</p>

Section 5 - Recommendations

1. *Service contracts must be used for single or multiple projects with an attached Purchase Order. All Contractors shall conduct a safety audit prior to starting work.*
2. *Establish a process for auditing safety and security practices of all BCF contractors on a scheduled basis.*
3. *A review and risk assessment of all trestles managed by BCF to determine/ identify similar safety concerns regarding restricted vehicle use.*
4. *Where possible cctv shall be activated and fully operational prior to the start of on site work projects.*
5. *Where warranted through risk assessment findings, dedicate an on-site BCF employee and an employee from the contracted service to remain on the work site at all times with the sole responsibility of communicating safety concerns and monitoring the work site progress.*
6. *When permanently installed safety equipment is removed from a work site, temporary safety markers shall be utilized and maintained to identify high risk areas throughout the on site project work.*
7. *When a structural review or inspection report contains recommendations for repair or replacement of infrastructure, a BCF reporting procedure should be developed to acknowledge and respond to the report prior to the commencement of work.*
8. *Develop a policy and guideline for Terminal Maintenance in Engineering Fleet Regulations that:*
 - *Develops a risk assessment template including an orientation guideline and standard check off list*
 - *Defines when a risk assessment should be completed*
 - *Defines what type and level of work/project requires a risk assessment*
 - *Develop a training program for persons completing risk assessments*
 - *Include in the policy and guideline what the acceptable risk is for employees regarding hours of work and the assurance of adequate rest prior to work assignment.*
9. *Review current Terminal Maintenance resources in order to determine if any planning support is required.*

APPENDIX A - Photographs

Close up view of damage to trestle after clean up



View of asphalt truck in water



APPENDIX B – Plan view of Nanaimo Harbour Trestle

